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Determination of qualitative and quantitative content of microelements in the leaves, roots and seeds of *Rumex crispus* L. (Polygonaceae) flora of palestine using atomic absorption spectroscopy technique

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Abstract
The aim of the research is to study the qualitative and quantitative content of microelements in the leaves, roots and seeds of the sorrel plant, (*Rumex crispus* L.), which is considered a plant of Palestine.
Using the atomic absorption spectroscopic method, which relies on the evaporation of plant ash, photographic recording of the radiation decomposed into a spectrum and measuring the intensity of the lines.
As a result of studying the elemental composition in the studied organs of the plant (*Rumex crispus* L), it can be noted that the quantity and quality of the elements depends on the growth conditions and the stage of the vegetation. After analyzing the research results:
It was found that the high microelement content in the root is manganese 320, copper 170, zinc 688, titanium 335, iron 1730, and aluminum 6910, while the high microelement content in the leaves it is manganese 188, zinc 262, cerillium 510, titanium 380, iron 1140, and aluminum 3010, and the high microelement content in the fruits it is copper 183, zinc 153, and titanium 1 44 and iron 1220 and we note here there is a tendency toward its significant accumulation not only in underground organs, but also in leaves and fruits.
This study is considered the first of its kind and its results are important because it is conducted provides data on the elemental composition of the roots, leaves, and fruits of the sorrel plant (*Rumex crispus* L.), which grows in Palestine, so that these results can be used in the chemical, biological, and environmental evaluation of the plant.
Among the most important recommendations: Chemical researchers in general, and botanists in particular, must pay attention to studying the active components in Palestinian plants, work to separate them, identify them, and learn about their therapeutic effects, so that these plants can be used not only in traditional medicine, but in modern medicine as well.

Keywords: *Rumex crispus* L, polygonaceae, roots leaves, fruits, microelement content, plants of Palestine

1. Introduction
The second-biggest genus in the Polygonaceae family is Rumex [1]. This plant, which has a variety of active ingredients with a wide range of pharmacological effects, is employed in traditional and official medicine [2-3]. These chemicals include anthraquinones, flavonoids, catchen, tannins, and others [4].
Rumex L. plants are widely distributed in North America, Kazakhstan, the Far East, Central and Eastern Europe, and portions of the Caucasus, Russia, and East Asia [1].
More than 200 species of Rumex plants may be found worldwide [1]. The genus Rumex is widely dispersed, with over 150 species found in tropical and subtropical parts of the globe of plants [2]. Palestine is home to 14 different species [5]. Which of the following species of Rumex: Rumex bucephalophorus, Rumex conglomeratus, Crispus, Cyprius, Dentatus, Maritimus, nepalensis, occultans, Pictus, and Pulcher Rumex vesicarius, Rumex roseus, Rumex rothschildianus, and Rumex tuberosus [6].
Plants of the genus Rumex are widely used as laxatives, astringents, hemostatics, anti-inflammatory, and dermatological treatments in traditional Palestinian medicine [4].
Research in modern pharmacology demonstrates their enormous potential for development, use, and therapeutic impact in eight areas: antiviral, cardiovascular, hepatoprotective, antioxidant, anti-corrosion, anti-tumor, and immunological modulation [5].

Only a few investigations have been done on the pharmacological properties and chemical makeup of the about 14 rumex species that are grown in Palestine (4-5) [7].
Therefore, we chose (*Rumex crispus* L.) as our study subject from among the flora of Palestine.
The objective of this research was to examine the microelement content, both qualitative and quantitative, in the leaves, roots, and seeds of *Rumex crispus* L. (Polygonaceae) flora found in Palestine, which had not been previously investigated.
Because there is little research on the microelement content of Rumex, it is crucial to look at the microelement content of these plants' roots, leaves, and fruits from both a scientific and practical standpoint.
It is well recognized that micro and trace elements are essential to plant biology and human metabolic processes. Furthermore, trace elements are crucial for the synthesis of bioactive chemical compounds in medicinal herb plants, which gives these plants their therapeutic and poisonous qualities [8-9].
The rhizomes, roots, and fruits of *Rumex crispus* L. flora in Ukraine were found to contain anthraquinones (emodin, chrysophanol, fiscion, chrysophanein, glucoemodin), flavonoids (rutin, hyperoside, quercetin), catechins, leukoanthocyanidins, tannins, hydroxycinnamic acids (Caffeic, chlorogenic), oxalic and ascorbic acids, and coumarins [10]. This was realized after realizing that the Ukrainian species *Rumex crispus* L. had been studied, classified, and its chemical composition established in the past.

2. Materials and Methods

2.1. Plant Material

Rumex crispus L. fruits leaves, and roots were harvested in July, May, and June, respectively, from the region around Tulkarm in Palestine, and were included in the study.
The raw materials were crushed, let to air dry, and then sieved through a sieve that had a 1 mm diameter.

2.2. Methods

Method for the qualitative and quantitative content of microelements in the leaves, roots and seeds of *Rumex crispus* L. (Polygonaceae) flora of Palestine by the atomic absorption spectroscopic method (AAS), which relies on the evaporation of plant ash, photographic recording of the radiation decomposed into a spectrum and measuring the intensity of the lines [11-13].
Preparation of the analyzed sample consisted of careful charring of the plant material when heated in a muffle furnace (temperature no more than 500 °C) with pre-treatment of the samples with dilute sulfuric acid.
Evaporation of samples was carried out from the craters of graphite electrodes in an alternating current arc discharge (source of excitation of spectra of the IVS-28 type) at a current of 16 A and an exposure time of 60 s. To obtain spectra and record them on photographic plates, a DFS-8 spectrograph with a diffraction grating of 600 lines/mm and a three-lens slit illumination system was used. The intensity of lines in the spectra of the analyzed samples and calibration samples (CS) was measured using an MF-1 micro photometer.
The following lines were photo metered in the spectra of samples and calibration samples (CS) (nm): A1 -308.2; Ag-328.0; As-286.0; B-249.6; Bi-306.7; Cd-326.1; Co-345.3; Cr -302.1; Cu- 324.7; Ga-294.3; Ge-303.9; Hg- 253.6; Mn-280.1; Mo-317.0; Ni-305.0; Pb-283.3; Sb-259.8; Sn-303.4; Sr-346.4; Ti-307.8; Zn-328.2.
When analyzing, the lower limits of the determined content of impurities in the ash residue of plants are taken into account, which for Cu is – 1.10^{-4}; Co, Cr, Mo, Mn, V-2.10^{-4}; Ag, Ga, Ge, Ni, Pb, Sn, Ti-5.10^{-4}; Cd-5.10^{-3}; Sr, Zn-1.10^{-2}.
Relative standard deviations for different elements with contents in ash exceeding the lower limit by 5-10 times are 0.12-0.20.

Taking measurements

The devices were prepared for operation in accordance with the instructions for their use.
The following conditions for photographing the spectra were observed: AC arc current-16A; ignition phase-60^0C; ignition pulse frequency-100 discharges per second; analytical gap-2 mm; spectrograph-slit width-0.015 mm; exposure-60 s.
The spectra were photographed in the spectral region of 230-330 nm. The photographic plates were developed, dried, and then the following lines in nm in the spectra of samples and calibration samples (CS), as well as the background near them, were photo metered: Ag-328.0; Cu –324.7; Mo-317.0; V-318.3; Cd-326.1; Ga-294.3; Ni-305.0; Sn-303.4; Co –345.3; Ge-303.9; Pb-283.3; Sr-346.4; Cr-302.1; Mn-280.1; Ti– 307.8; Zn –328.2.
For each element, based on the photometric results, the differences in line and background blackening ($S = S_{n+\phi}-S_{\phi}$) were calculated for the spectra of samples (S_{sample}) and calibration samples (CS), (S_{cs}). Then a calibration graph was constructed in the coordinates: the average value of the difference between the blackening of the line and the background (S_{cs})-the logarithm of the element content in calibration samples (CS), (log C), where C is expressed as a percentage of the base.
Using this graph, the content of the element in the ash (a), expressed as a percentage, was found. The element content in plant material was found using the formula:

$$x = \frac{a \cdot m}{M}$$

Where
m: is the mass of ash, g;
M: is the mass of raw materials taken for analysis, g.
Each calibration samples (CS), was ground with alcohol (50 ml) for 2 hours. After drying the powder, it was ground for another 1 hour. Calibration samples (CS), No. 1 (without introduced elements) was ground with alcohol and dried like all other calibration samples (CS).
Each calibration samples (CS), (No. 1-9) was ground with carbon powder in a 1:1 ratio by weight for 1 hour.
A weighed portion of dry raw materials (Rhizomes with roots, leaves, fruits) of at least 3 g was added to a quartz crucible (Weighing error 0.0002 g). They were moistened with 10 ml of a 5% sulfuric acid solution, dried in an oven at a temperature of 100°C, and then on an electric stove until the sulfuric acid vapors were removed. The crucible was transferred to a cold muffle furnace. The furnace temperature was gradually raised to 500□C and calcined for 1 hour. Cooled and weighed.
The same amount (by weight) of graphite powder was added to the resulting ash and thoroughly mixed in a Plexiglas's mortar. The resulting sample and workers calibration samples (CS), No. 9-No. 1 were stuffed into the craters of the upper

and lower electrodes. For each sample and calibration samples (CS), at least three electron pairs were prepared: Ga-2943, Zn-328.2; Ge-303.9.

For quantitative analysis, artificially prepared calibration (standard) samples specific for each type of substance were used.

The technique used is intended to determine micro impurities in materials of plant origin (rhizomes with roots, leaves, fruits) after their ashing. Defined interval contents (mass% to ash) is: Mn-from 2.10^{-4} to 1; Cu-from 1.10^{-4} to 5.10^{-2}; Ni, Ge, Pb, Ga, Ag, Sn-from 5.10^{-4} to 1.10^{-2}; Cd-from 5.10^{-3} to 1.10^{-2}; V, Mo, Co, Cr-from 2.10^{-4} to 1.10^{-2}; Ti-from 5.10^{-4} to 1; Sr-from 1.10^{-2} to 1; Zn-from 1.10^{-2} to 2.

The measurement method-atomic emission graphic-is based on the evaporation of plant ash mixed with graphite from the craters of graphite electrodes, followed by the excitation of light in an alternating current arc discharge.

The basis for the preparation of calibration samples (Hereinafter referred to as the "base") is a mixture of metal oxides and salts corresponding to the composition of the herbs (Leaves). To prepare 200 g of base, we took weighed samples of the following substances (g): SiO_2-36, K_2SO_4-40, $CaCO_3$-40, KCl-14, Mg0-10, Na_2S0_4-30, KH_2PO_4-30.

The taken samples and fluoroplastic balls were placed in a fluoroplastic glass with a lid. Mixing of the base components was carried out in a ball mill with a drum rotation speed of 80 rpm for 6 hours. The resulting mixture was calcined in quartz crucibles in a muffle furnace at 500°C for 5 hours.

Preparation of calibration samples: Calibration samples (CS) were prepared by serial dilution with the base of the original calibration samples (CS), (No. 9), in which the mass fraction of Cu is 0.5%; Mn, Ag, Ga, Ge, Ti, Pb, Ni, V, Mo, Co, Sn, Sr, Cr is 1%; Cd and Zn-2% (in terms of metal). calibration samples (CS), (No. 9) was prepared by thoroughly mixing the base and oxides of the metals being determined in a fluoroplastic mortar for 4 hours in the presence of alcohol (50 ml) and 2 hours after evaporation of the alcohol; the metal oxides were first brought to constant weight in an oven at 120°C and in a muffle furnace (for TiO_2, V_2O_5) at 1000^0C.

To prepare 10 g of calibration samples (CS), (No. 9), the following masses of samples were taken, g (weighing error no more than 0.0002 g):

Bases-7.6311, ZnO-0.2488, MoO_3-0.1500, MnO_2-0.1582, TiO_2-0.1668, Co_2O_3-0.1407, AgCl-0.0664, PbO-0.1077, SnO_2-0.1269, Ga_2O_3-0.1344, CuO-0.0682, $SrCO_3$-0.1685, GeO_2-0.1441, Ni_2O_3-0.1409, Cr_2O_3-0.1461, CdO-0.2284, V_2O_5-0.1784.

A set of calibration samples (CS), with additives of determined elements in the content range 1.10^{-1}-$2.5.10^{-4}$ (Calibration samples (CS), No. 8-No. 1) was prepared by serial dilution of calibration samples (CS), No. 9 with a base, as indicated in Table 1

Table 1: Preparation of a set of calibration samples

No CS	Cu	Entered as % of the base Mn, Ag, Ga, Ge, Cd, Ti, Pb, Ni, V, Mo, Co, Cr, Sr	Zn, Cd	No added CS	Weightadded CS, g	Weight basics, g
1.	—	—	—	—	—	10
2.	$1,2.10^{-4}$	$2,5.10^{-4}$	5.10^{-4}	5	1	9
3.	$2,5.10^{-4}$	5.10^{-4}	1.10^{-3}	6	1	9
4.	$5,0.10^{-4}$	1.10^{-3}	2.10^{-3}	7	1	9
5.	$1,2.10^{-4}$	$2,5.10^{-3}$	5.10^{-3}	7	2,5	7,5
6.	$2,5.10^{-3}$	5.10^{-3}	1.10^{-2}	8	0,5	9,5
7.	$5,0.10^{-3}$	1.10^{-2}	2.10^{-2}	8	1	9
8.	$5,0.10^{-2}$	1.10^{-1}	2.10^{-1}	9	1	9

The results of determining the content of trace elements using the atomic emission spectrographic method are presented in Table 2

3. Results and Discussion

The purpose of the study is to investigate the microelement content, both qualitative and quantitative, for the first time in the leaves, roots, and seeds of the sorrel plant (*Rumex crispus* L.), which is regarded as a plant native to Palestine.

Employing the plant ash-based atomic absorption spectroscopic approach, which measures the strength of the lines by taking pictures of the radiation as it breaks down into a spectrum. It is evident by examining the elemental composition of the plant's (*Rumex crispus* L) examined organs that the growing environment and stage of the vegetation affect both the amount and quality of the elements. Following analysis of the study findings:

Manganese 320, copper 170, zinc 688, titanium 335, iron 1730, and aluminum 6910 were found to have high microelement content in the root. Manganese 188, zinc 262, cerillium 510, titanium 380, iron 1140, and aluminum 3010 were found to have high microelement content in the leaves. Copper 183, zinc 153, titanium 1 44, and iron 1220 were found to have high microelement content in the fruits. We note that there is a tendency for its significant accumulation not only in subterranean organs but also in leaves and fruits. Table 2

This study, which is thought to be the first of its kind, is significant because it provides information on the elemental composition of the leaves, fruits, and roots of the sorrel plant (*Rumex crispus* L.), which grows in Palestine. This information can be used to evaluate the plant's chemical, biological, and environmental qualities.

One of the most significant recommendations is that, in order for Palestinian plants to be used in both traditional and modern medicine, chemical researchers in general and botanists in particular must focus on studying the active components in Palestinian plants, work to separate them, identify them, and learn about their therapeutic effects.

4. The value of study

The research is significant since it is the first to look at the microelement content, both qualitative and quantitative, in the leaves, roots, and seeds of the sorrel plant (*Rumex crispus* L.), Flora plant from Palestine.

Table 2: Content of microelements in the vegetative and generative organs of *Rumex crispus*, mg/kg

№	Element	Parts of the *Rumex crispus* L. that were studied		
		Rhizomes with roots	Leaves	Fruit
1	Mn	320	188	26
2	Cu	170	63	183
3	Pb	9	14	3
4	Ni	24	15	2
5	Co	1	<0,4	<0,4
6	Mo	0,4	<0,3	<0,4
7	Zn	688	262	153
8	V	14	10	0,4
9	Sr	37	510	42
10	Ti	335	380	144
11	Sn	3	<0,4	<0,4
12	Ga	52	3	0,1
13	Ag	2	<0,04	<0,04
14	Fe	1730	1140	1220
15	Al	6910	3010	0,2
16	Cd	<0,1	<0,1	<0,1
17	As	<0,2	<0,2	<0,2
18	Hg	<0,01	<0,01	<0,01
19	Sb	<0,4	<0,4	<0,6
20	Cr	12	5	5
21	Bi	<0,4	<0,3	<0,3
22	Ge	<0,2	<0,2	<0,1

5. Recommendations

Chemical researchers in general, and botanists in particular, must pay attention to studying the active components in Palestinian plants, work to separate them, identify them, and learn about their therapeutic effects, so that these plants can be used not only in traditional medicine, but in modern medicine as well.

6. Conclusions

For the first time, research has been done on the quantitative and qualitative examination of the microelement content, in the leaves, roots, and seeds of the (*Rumex crispus* L.), which is regarded as a plant native to Palestine.

This study offers a thorough analysis of the 22 trace element concentrations in the samples examined. The approach employed was the dry ash method in conjunction with atomic absorption spectrometry, which is regarded as dependable for identifying regular analytic components in a variety of plants and dietary supplements.

The results obtained from the current study indicate a high percentage of microelements in the studied parts and provide justification for the use of *Rumex crispus* in the daily diet for nutrition, such as adding it to salads, as well as for medical use in treating various diseases.

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